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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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05/25/2006

Yoshimichi Harada

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09/14/2010

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EXAMINER

CRAWFORD, LATANYA N

ART UNIT

PAPER NUMBER

2813

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PAPER

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

<b>Office Action Summary</b>	<b>Application No.</b> 10/580,606	<b>Applicant(s)</b> HARADA ET AL.	
	<b>Examiner</b> LATANYA CRAWFORD	<b>Art Unit</b> 2813	

**-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --**

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 17 June 2010.
- 2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-78 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 74-78 is/are allowed.
- 6) ☒ Claim(s) 1-73 is/are rejected.
- 7) ☒ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 25 May 2006 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All    b) ☐ Some \*    c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |   |   |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)         | 4) <input type="checkbox"/> Interview Summary (PTO-413)           |
| 2) <input type="checkbox"/> Notice of Draftperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____                                      |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)         | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date _____   | 6) <input type="checkbox"/> Other: _____                          |

### **DETAILED ACTION**

1. This office action is in response to the correspondence filed on 6/17/2010.

Currently, claims 1-78 are pending.

#### ***Response to Arguments***

2. Applicant's arguments, see remarks, filed 6/17/2010, with respect to Hayashi and Kashiwagi have been fully considered and are persuasive. The rejection has been withdrawn.

#### ***Claim Objections***

3. Claim 46 is objected to because of the following informalities: in line 5-6, pp. 9 the claim recites "a least", the claim should recites **at least**. Appropriate correction is required.

4. Claim 64 is objected to because of the following informalities: in line 5-6, pp. 12 the claim recites "a least", the claim should recites **at least**. Appropriate correction is required.

5. Claim 74 is objected to because of the following informalities: in line 6, pp. 14 the claim recites "a least", the claim should recites **at least**. Appropriate correction is required.

#### ***Claim Rejections - 35 USC § 112***

6. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

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7. Claims 1, 5-7,9-17,19-21, & 40 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

8. Claim 1 recites "at least one unsaturated hydrocarbon group bound with a side chain of a skeleton". Is the unsaturated hydrocarbon bound to a side chain of said skeleton (meaning said skeleton of silicon and oxygen) or is there another skeleton that the hydrocarbons are bound to?

9. Claims 2, 3, 4, 8, 18, 30, 31, 38, & 41 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

10. Claim 2 recites at least one unsaturated hydrocarbon group bound with a side chain of a skeleton". Is the unsaturated hydrocarbon bound to a side chain of said skeleton (meaning said skeleton of silicon and oxygen) or is there another skeleton that the hydrocarbons are bound to?

11. Claims 46-73 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

12. Claims 46 & 64 recites "wherein said saturated hydrocarbon group has a least two carbon atoms." However, Examiner notes that the claim only refers back to an unsaturated hydrocarbon. The Examiner is uncertain if the claim requires unsaturated hydrocarbon only? Saturated hydrocarbon only? or unsaturated and saturated

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hydrocarbons? To further prosecution, the Examiner will interpret that the claim only requires a saturated hydrocarbon.

***Claim Rejections - 35 USC § 102***

13. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

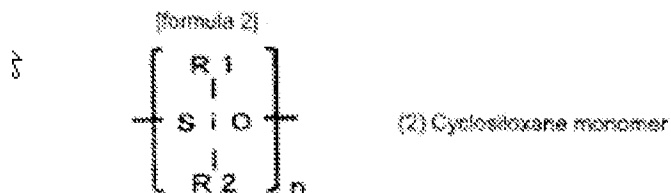
(a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.

14. Claims 1-3,5,6,9-12, 18, 30,31,38,40, 41,46-49,54,57-58, & 64-66 are rejected under 35 U.S.C. 102(a) as being anticipated by Matsuki (US Pub no. 2003/0162408 A1)

Regarding claim 1, Matsuki et al. discloses a method of producing a porous insulating film, comprising the step of: introducing gas containing vapor of cyclic organic silica compounds, which have silicon and oxygen skeletons and have at least one unsaturated hydrocarbon group bound with a side chain of a skeleton (1,3,5-trimethyl-1,3,5-trivinylcyclotrisiloxane), and which is diluted with an inert gas, into plasma to grow a porous insulating film on a semiconductor substrate[0019] [0025][0035-0036][0084-0087].

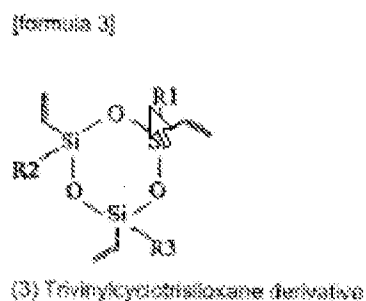
Regarding claim 5, Matsuki et al. discloses wherein said cyclic organic silica compounds are cyclosiloxane monomers represented by the following formula (2):

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where R1 and R2 are respectively any one of the group consisting of hydrogen, an alkyl group, an alkoxide group, an amino group, alkene, alkyne, a phenyl group and a phenol group, provided that R1 and R2 may be the same or different, provided that at least one of the side chain groups is an unsaturated hydrocarbon group, and n is an integer of 2 or more [0035-0036].

Regarding claim 6, Matsuki et al. discloses wherein said cyclic organic silica compounds are trivinylcyclotrisiloxane derivative monomers represented by the following formula (3) [0035-0036]:



Regarding claim 9 & 10, Matsuki et al. discloses wherein said plasma is plasma of rare gas (Ar)[0082]; wherein said plasma is plasma of mixture gas of rare gas and oxidizer gas [0087].

Regarding claims 11-12, Matsuki et al. discloses a porous insulating film produced by the method of producing a porous insulating film according to claim 1 [0019] [0025][0035-0036][0084-0087]; comprising at least silicon, carbon, oxygen and hydrogen and having a Raman spectrum corresponding to at least three-membered silica skeleton in the Raman spectroscopic analysis [0035-0036] (presumed inherent MPEP2112.01)

Regarding claim 40, Matsuki et al. discloses introduced gas consists of a vapor of cyclic organic silica compounds and the inert gas [0019][0029-0031][0025][0042-0045][0084-0087].

Regarding claim 2, Matsuki et al. discloses a method of producing a porous insulating film, comprising the step of: introducing vapor of cyclic organic silica compounds, which have silicon and oxygen skeletons and have at least one unsaturated hydrocarbon group bound with a side chain of a skeleton  $(\text{Si}_n\text{O}_n\text{R}_{2n-m})\text{X}_m$  (refer to [0030] where R is  $\text{C}_{1-6}$  saturated or unsaturated hydrocarbons/ or 1,3,5-trimethyl-1,3,5-trivinylcyclotrisiloxane) [0035-0036](Examiner notes that Matsuki et al teaches that all of the aforesaid compounds can be used in a combination of atleast two of any compunds; compounds are disclosed in [0042-0052] and which is diluted with an inert gas [0019], and vapor of straight-chain organic silica compounds, which have silicon and oxygen skeletons and have any one selected from the group consisting of hydrogen, a hydrocarbon group and a hydrocarbon oxide group bound with a side chain of a skeleton( $\text{X}_m$  as referred to in [0037] can be  $\text{CH}_3\text{COO-Si}(\text{CH}_3)_2\text{-OOCCH}_3$ / Examiner

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notes that Matsuki et al teaches that all of the aforesaid compounds can be used in a combination of atleast two of any compounds; compounds are disclosed in [0042-0052] ), and which is diluted with an inert gas, into plasma to grow a porous insulating film on a semiconductor substrate [0019][0037][0030][0084-0087].

Regarding claim 3, Matsuki et al. discloses wherein said straight-chain organic silica compounds have a structure represented by the following formula (1)



where R1 to R6 which may be the same or different, respectively represent any one selected from the group consisting of hydrogen, a hydrocarbon group and a hydrocarbon oxide group [0041][0049] (Examiner notes that Matsuki et al teaches that all of the aforesaid compounds can be used in a combination of atleast two of any compounds; compounds are disclosed in [0042-0052] ).

Regarding claims 30 & 31, Matsuki et al. discloses a porous insulating film produced by the-method of producing a porous insulating film according to claim 2 (refer to rejection of claim 2/3); semiconductor device using the porous insulating film produced by the method of claim 30 [0005].



Regarding claim 18, Matsuki et al. discloses wherein said straight-chain organic silica compounds have a structure represented by said formula (1)( refer to rejection in claim 2 & 3).

Regarding claim 38, Matsuki et al. discloses wherein said cyclic organic silica compounds have a saturated hydrocarbon group bound with another side chain of said skeleton, and wherein said saturated hydrocarbon group has at least two carbon atoms(1,3,5-trimethyl-1,3,5-trivinylcyclotrisiloxane) [0035-0036](Examiner notes that Matsuki et al teaches that all of the aforesaid compounds can be used in a combination of atleast two of any compounds; compounds are disclosed in [0042-0052] ).

Regarding claim 41, Matsuki et al. discloses introduced gas consists of a vapor of cyclic organic silica compounds and the inert gas [0019][0029-0031][0025][0042-0045][0084-0087].

Regarding claim 46, Matsuki et al. discloses a method of producing a porous insulating film, comprising the step of: introducing gas containing vapor of cyclic organic silica compounds which have silicon and oxygen skeletons and have at least one unsaturated hydrocarbon group bound with a side chain of a skeleton, and which is diluted with an inert gas, into plasma to grow a porous insulating film on a semiconductor substrate, wherein said saturated hydrocarbon group has a least two carbon atoms[0019] [0027][0030][0084-0087].

Regarding claim 47, Matsuki et al. discloses wherein the cyclic organic silica compounds enter into a polymerization reaction by plasma energy and thermal energy from a substrate heating part to grow said porous insulating film [0084].

Regarding claim 48, Matsuki et al. discloses wherein a temperature of the substrate heating part is from 200 to 450 °C [0084].

Regarding claim 49, Matsuki et al. discloses wherein a raw material :of the cyclic organic silica compounds is heated under reduced pressure to be gasified [0084].

Regarding claim 54, Matsuki et al. discloses further comprising the step of introducing oxidizer gas with the vapor of cyclic organic silica compounds into plasma [0084-0087].

Regarding claim 57-58, Matsuki et al. discloses wherein the oxidizer gas is selected from N<sub>2</sub>O [0053]. In view of claim 57 Matsuki teaches N<sub>2</sub>O ; claim 58 requires alcohol as an alternative and required by claim 58. Since claim 58 depends from 57, alcohol is not considered since claim 57 has been satisfied with N<sub>2</sub>O.

Regarding claim 64, Matsuki et al. discloses a porous insulating film produced by the method comprising the step of: introducing gas containing vapor of cyclic organic silica compounds which have silicon and oxygen skeletons and have at least one unsaturated hydrocarbon group bound with a side chain of a skeleton, and which is diluted with an inert gas, into plasma to grow a porous insulating film on a semiconductor substrate, wherein said saturated hydrocarbon group has a least two carbon atoms[0019] [0027][0030][0084-0087].

Regarding claims 65-66, Matsuki et al. discloses wherein the cyclic organic silica compounds have a six-membered ring structure consisting of three silicon atoms and three oxygen atoms [0035-0036]; having a spectrum corresponding to at least a three-membered silica skeleton when analyzed by Raman spectroscopy[0019] [0025][0030][0084-0087] (presumed inherent MPEP2112.01).

**. Claim Rejections - 35 USC § 103**

15. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

16. Claims 7, 13-15,16,19-21, 23-29,29, 40, 45, 50-53,62, 72-73 are rejected under 35 U.S.C. 103(a) as being unpatentable over Matsuki (US Pub no. 2003/0162408 A1).

Regarding claim 7, Matsuki et al. discloses all the claim limitations of claim 5 and further teaches a generic formula of  $(\text{Si}_n\text{O}_n\text{R}_{2n-m})$  where in "n" is an integer from 3-6; unsaturated hydrocarbons from 1-6 ( $m \leq n$ );having at least one vinyl group [0031-0032] but fails to teach tetravinyltetramethylcyclotetrasiloxane. One of ordinary skill in the art would at once envisage the subject matter within claim 7 of the reference. In re Meyer, 599 F.2d 1026, 202 USPQ 175 (CCPA 1979)

. Regarding claims 13-15, Matsuki et al. discloses all the claim limitations of claim 11 and further teaches a generic formula of  $(\text{Si}_n\text{O}_n\text{R}_{2n-m})$  where in "n" is an integer from 3-6; unsaturated hydrocarbons from 1-6 ( $m \leq n$ );having at least one vinyl group [0031-0032] but fails to teach wherein the ratio of elements in the film: O/Si = 0.8 to 1.2, C/Si =

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1.5 to 10.0 and H/Si = 4.0 to 15.0; and the diameter of pores contained in the film is 3 nm or less; and pores contained in the film have almost the same diameters as a skeleton of said cyclic organic silica compounds. One of ordinary skill in the art would at once envisage the subject matter within claims 13 of the reference. In re Meyer, 599 F.2d 1026, 202 USPQ 175 (CCPA 1979) and result in pore diameters of 3 nm or less and also having the same features of claim 15 (same composition same process) .

Regarding claim 16, Matsuki et al. discloses a layer insulating film of a multilayer wiring [0005].

Regarding claim 19, Matsuki et al. discloses wherein said cyclic organic silica compounds are cyclosiloxane monomers represented by said formula (2), where R1 and R2 are any one selected from the group consisting of hydrogen, an alkyl group, an alkoxide group, an amino group, alkene, alkyne, a phenyl group and a phenol group, provided that R1 and R2 may be the same or different, provided that at least one of side chain groups is an unsaturated hydrocarbon group, and n is an integer of 2 or more [0035-0036].

Regarding claim 20, Matsuki et al. discloses all the claim limitations of claim 19 and further teaches a generic formula of  $(Si_nO_nR_{2n-m})$  where in "n" is an integer from 3-6; unsaturated hydrocarbons from 1-6 ( $m \leq n$ ); having at least one vinyl group [0031-0032] but fails to teach tetravinyltetramethylcyclotetrasiloxane. One of ordinary skill in the art would at once envisage the subject matter within claim 20 of the reference. In re Meyer, 599 F.2d 1026, 202 USPQ 175 (CCPA 1979)

Regarding claim 21, Matsuki et al. discloses wherein said cyclic organic silica compounds are trivinylcyclotrisiloxane derivative monomers represented by said formula (3) [0058].

Regarding claim 23, Matsuki et al. discloses a porous insulating film, wherein the specific inductive capacity is equal to or greater than 2.1 and equal to or smaller than 2.7 and wherein pores within said porous insulating film are enclosed within silica skeletons formed from polymerized cyclic organic silica molecules [0036]. Since Matsuki et al. teaches the same cyclic organic silica with unsaturated hydrocarbon and straight chained organic silica with unsaturated hydrocarbon diluted in inert gas with a plasma a prima facie case of obviousness exists that it would be reasonably expected that the process disclosed by Matsuki et al. would result in a porous insulating film having a distribution of pore diameter with a single peak. *In re Fitzgerald*, 619 F.2d 67, 70, 205 USPQ 594, 596 (CCPA 1980) (quoting *In re Best*, 562 F.2d 1252, 1255, 195 USPQ 430, 433-34 (CCPA 1977)).

Regarding claims 24-27, Matsuki et al. teaches all the claim limitations of claim 23 and further teaches a generic formula of  $(Si_nO_nR_{2n-m})$  where in "n" is an integer from 3-6; unsaturated hydrocarbons from 1-6 ( $m \leq n$ ); having at least one vinyl group [0031-0032], but fails to teach a porous insulating film having wherein a ratio of elements in the film is C/Si = 1.5 to 10.0, ratio of elements in the film is O/Si = 0.8 to 1.2, ratio of elements in the film is H/Si = 4.0 to 15.0, and a pore diameter at the maximum frequently appearance is equal to or smaller than 1  $\mu m$ . Since Matsuki et al. teaches the same process and same materials it would be reasonably expected by one of ordinary

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skill in the art that the features as claimed would result. One of ordinary skill in the art would at once envisage the subject matter within claims 24-26 of the reference. In re Meyer, 599 F.2d 1026, 202 USPQ 175 (CCPA 1979)

Regarding claim 28, Matsuki et al. discloses comprising three membered silica [0035-0036].

Regarding claim 29, Matsuki et al. discloses a semiconductor device using the porous insulating film according to claim 23 as a layer insulating film[0005].

Regarding claim 44 & 45, Matsuki et al. discloses a wiring layer, wherein the porous insulating film is located between a wire of the wiring layer and other wiring layer [0005].

Regarding claim 50, Matsuki et al. discloses all the claim limitations of claim 47, but fails to teach polymerization reaction runs under a condition that a power density of plasma formation is from  $0.141 \text{ W/cm}^2$  to  $0.424 \text{ W/cm}^2$ . Limitations of claim 50 are result effective variables in order to optimize pore size and would have been obvious to one of ordinary skill.

Regarding claim 51-53, Matsuki et al. teaches Matsuki et al. teaches all the claim limitations of claim 23 and further teaches a generic formula of  $(\text{Si}_n\text{O}_n\text{R}_{2n-m})$  where in "n" is an integer from 3-6; saturated hydrocarbons from 1-6 ( $m \leq n$ ); having at least one vinyl group [0031-0032], but fails to teach wherein a composition ratio C/Si of the porous insulating film is 2.11 smaller than or equal to a composition ratio C/Si of the cyclic organic silica compounds; a composition ratio O/Si of the porous insulating film is 0.112

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greater than or equal to a composition ratio O/Si of the cyclic organic silica compounds; a composition ratio H/Si of the porous insulating film is 3.90 smaller than or equal to a composition ratio H/Si of the cyclic organic silica compounds. Since Matsuki et al. teaches the same process and same materials it would be reasonably expected by one of ordinary skill in the art that the features as claimed would result. One of ordinary skill in the art would at once envisage the subject matter within claim 51-53 of the reference. In re Meyer, 599 F.2d 1026, 202 USPQ 175 (CCPA 1979)

Regarding claim 59, Matsuki et al. discloses all the claim limitations of claim 11 and further teaches a generic formula of  $(\text{Si}_n\text{O}_n\text{R}_{2n-m})\text{X}_m$  [0027] but fails to teach One of ordinary skill in the art would at once envisage the subject matter within claim 59 of the reference In re Meyer, 599 F.2d 1026, 202 USPQ 175 (CCPA 1979).

Regarding claim 62, Matsuki et al. discloses wherein the cyclic organic silica compounds have a six-membered ring structure consisting of three silicon atoms and three oxygen atoms [0027][0031].

Regarding claims 72-73, Matsuki et al. discloses all the claim limitations of claim 64. Since Matsuki teaches the same materials and same process [0019] [0025] [0027/0030] [0084-0087], it would have been obvious to one of ordinary skill in the art at the time the invention was made that wherein pores in the porous insulating film have the same diameters as skeletons of the cyclic organic silica compounds; and a diameter of pores in the insulating film is smaller than 0.5nm will result.

***Allowable Subject Matter***

17. Claims 74-78 are allowed.
18. The following is a statement of reasons for the indication of allowable subject matter: The prior art of record does not anticipate nor render obvious limitations of base claims 74 including: wherein said saturated hydrocarbon group has at least two carbon atoms as instantly claim in combination with the remaining elements of the claim.

***Inquiry***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to LATANYA CRAWFORD whose telephone number is (571)270-3208. The examiner can normally be reached on Monday-Friday 7:30 AM - 5:00 PM EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Matthew Landau can be reached on (571)-272-1731. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.



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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Matthew C. Landau/  
Supervisory Patent Examiner, Art  
Unit 2813

/LaTanya Crawford/  
Examiner, Art Unit 2813